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Pacific Region

Canadian Science Advisory Secretariat
Science Advisory Report 2012/057

RECOVERY POTENTIAL ASSESSMENT FOR THE NORTHERN FUR SEAL (*CALLORHINUS URSINUS*) IN CANADIAN WATERS

Northern fur seals (Callorhinus ursinus)
Photo by: A. W. Trites

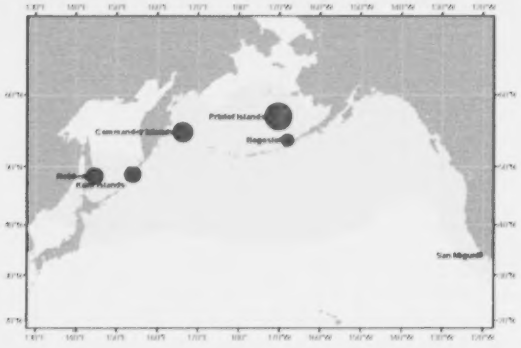

Figure 1: Map showing the pelagic distribution of northern fur seals (grey shaded area) and location of breeding sites (red circles, with size proportional to pup production in 2005-2011)

Context :

When the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designates an aquatic species as threatened or endangered, Fisheries and Oceans Canada (DFO), as the responsible jurisdiction under the Species at Risk Act (SARA), is required to undertake a number of actions. Many of these actions require scientific information on the current status of the species, population or designable unit, threats to its survival and recovery, and the feasibility of its recovery. Formulation of this scientific advice has typically been developed through a Recovery Potential Assessment (RPA) that is conducted shortly after the COSEWIC assessment. This timing allows for the consideration of peer-reviewed scientific analyses into SARA processes including recovery planning.

In November 2010, COSEWIC determined that northern fur seals in Canada were threatened. The reason for the designation was that pup production on the Pribilof Islands, the largest breeding site and origin of the majority of animals migrating through Canadian waters, had declined by 38% over the last 30 years (3 generations). COSEWIC could not determine the cause of the decline, but noted it had persisted for the past 45 years. This RPA provides information and scientific advice required to meet various requirements under SARA, including public consultations, decisions regarding the listing of northern fur seals in Canadian waters under SARA, and developing a recovery strategy should the species be legally listed.

This Science Advisory Report is from the Fisheries and Oceans Canada, Canadian Science Advisory Secretariat, National Marine Mammal Review Committee annual meeting, 17-21 October 2011, Ottawa, Ontario. Additional publications from this process will be posted as they become available on the DFO Science Advisory Schedule at http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

November 2012

Canada

SUMMARY

- Northern fur seals inhabiting the North Pacific comprise a single population;
- The species does not breed and rarely comes ashore in Canada. However, fur seals undertake an extensive pelagic migration during the non-breeding season;
- During the pelagic migration, about 320,000 northern fur seals (30% of the population) winter along the west coast of North America (California to SE Alaska), with roughly one-third of them inhabiting Canadian waters during their peak abundance in May;
- Total abundance of northern fur seals has declined by approximately 14% from 1.3 million to 1.1 million over the last 30 years (3 generations). The decreases occurred at the largest breeding area on the Pribilof Islands; abundance at other breeding areas has been stable or increasing;
- Peak seasonal abundance of northern fur seals in Canadian waters has declined by roughly 28% from 165,000 to 118,000 over the last 30 years (3 generations);
- The cause of the decline on the Pribilof Islands is unknown, but potential threats include changes in prey availability, climate change, entanglement in debris, oil spills and contaminants;
- Population viability analyses indicate that if recent declines in pup production on the Pribilof Islands continue, there is little chance (0.1-0.3%) the subpopulation will be extirpated within the next 100 years, but the risk escalates if the declines were to persist beyond the next century;
- The distribution objective for ensuring the security of northern fur seals in Canada is to maintain viable breeding sites, which are located outside of Canada, and to provide suitable habitat within Canada for foraging seals during their annual migration;
- Specific population objectives have not been established for fur seals in Canada, but will need to consider the abundance, population trend, and migration patterns of animals associated with each breeding site. The large, declining Pribilof Island subpopulation currently has the greatest influence on abundance of seals in Canada, but the smaller, growing Bogoslof Island and large, stable Commander Island subpopulation have had increasing influence, whereas the distant breeding subpopulations in the Kuril Islands and Tyuleniy (Robben) Island have relatively little influence;
- Allowable harm limits have not been established for fur seals in Canada, but human-induced mortality is not considered to be a factor in the declines on the Pribilof Island, and human-induced mortality of fur seals in Canadian waters is currently negligible;
- Critical habitat in Canada has not been designated for fur seals, but historic data indicate the main wintering area was La Perouse Bank off SW Vancouver Island, which has been utilized predominantly during spring by adult females feeding mainly on herring;

BACKGROUND

Rationale for Assessment

In November 2010, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determined that the northern fur seal (*Callorhinus ursinus*) was threatened in Canadian waters. The reason for the designation was that pup production on the Pribilof Islands, the largest

breeding site and origin of the majority of animals migrating through Canadian waters, had declined by 38% over the last 30 years (3 generations). COSEWIC could not determine the cause of the decline, but noted it had persisted for the past 45 years.

As part of the Recovery Potential Assessment (RPA) process, scientific information is needed to support the development and assessment of social and economic cost and benefits of potential management scenarios for recovery to better inform public consultations and to support other entities involved in the decision of whether to add the species to Schedule 1 of the *Species at Risk Act* (*SARA*). If it is legally listed, the information will be used to develop a recovery strategy.

Species Biology and Ecology

The northern fur seal is a small pinniped, but exhibits extreme sexual dimorphism. Pups are black and average about 5-6 kg at birth, but more than triple in body mass during a 4 month nursing period, by which time they weigh about a third as much as their mothers. Adult females typically weigh 35-45 kg, with most growth completed by 5 years of age. Males continue to grow until about 10 years of age, typically attaining a body mass of 150-200 kg, with the largest territorial males weighing just over 300 kg. Females typically mature at 4-6 years of age with pregnancy rates varying from 75-90% for females in their reproductive prime (8-13 years of age), and older animals exhibiting reproductive senescence. Female longevity may exceed 25 years, but due to high juvenile mortality, mean life expectancy is about 5 years. Mean generation time is about 10 years. Maximum longevity of males may extend to 15 years, but mean life expectancy is just over 3 years.

The life cycle of northern fur seals consists of a 4-5 month breeding season during which mature animals come ashore at rookeries to give birth, nurse their young and mate, followed by a 7-8 month pelagic phase. Northern fur seals currently breed on 6 rookeries (Figure 1). The breeding season begins in May with the arrival of males, which stake out territories which they typically defend for 38-42 days (up to 87 days) while fasting. The breeding system is highly polygynous, with ratios of harem bulls to females ranging from about 9:1 in a natural population, to as high as 60:1 when subadult males are harvested, apparently with little effect on pregnancy rates. Females arrive on rookeries in late June or July and give birth to a single pup within a day or two. Mothers remain on land with the newborn pup for about a week, mate 3-8 days after parturition, and subsequently make a series of foraging trips lasting 4-10 days, punctuated by 1-2 day visits on land to nurse pups. The foraging trips continue until pups are weaned in November at about 4 months of age.

After breeding, animals undertake a 7-8 month pelagic migration. Pups depart from rookeries soon after being weaned in November. Immature animals become widely distributed in the North Pacific Ocean and tend to remain at sea during the first 2-3 years of life. Adult males tend to winter at northerly latitudes in the Bering Sea, Sea of Okhotsk or Gulf of Alaska. Adult females tend to winter in coastal areas over the continental shelf or along and offshore of the shelf break, but the subarctic-subtropical transition zone also appears to be an important wintering area and may serve as a southern barrier for fur seal prey species. Females from American breeding areas tend to winter along the North American coast, and females from Russian breeding areas tend to winter along the Asian coast, but there is considerable inter-mixing of subpopulations in wintering areas.

Northern fur seals generally exhibit a high degree of fidelity to natal birth areas, so each breeding area (or in some cases adjacent breeding areas) are considered subpopulations. However, tagging studies indicate there is also considerable exchange of both males and females among breeding areas. In some cases, females have dispersed from natal breeding

areas to establish new or re-populate former breeding areas. There is no evidence of genetic differentiation among breeding subpopulations.

ASSESSMENT

Population Status, Trends & Trajectory

Historically, fur seals in the North Pacific have experienced two major population declines. There may have been on the order of 2-3 million fur seals when the major breeding areas on the Commander Islands were discovered in 1742 and on the Pribilof Islands in 1786-87. Unregulated hunting at these breeding sites rapidly depleted the population. Russian sealers subsequently imposed restrictions on killing females, and the population recovered during a regime of selective male harvests.

The second decline was caused by pelagic sealing during 1868-1910, which took mainly females wintering in coastal areas. Victoria, B.C., served as the base for the sealing fleet after the U.S. prohibited American citizens from pelagic sealing in 1881. The fur seal population was again depleted, leading to the signing of the North Pacific Fur Seal Treaty in 1911, and the resumption of selective male harvests at breeding sites.

Northern fur seal population assessments since the early 1900s have been based on estimates or counts of pups, the only component of the population that is on land at any given time and can be enumerated. Pup numbers indicate fur seal populations recovered after pelagic fur sealing ended in 1911 (Figure 2). Pup production at the largest breeding area on the Pribilof Islands increased until the 1940s, but then stabilized. A large kill of females during 1956-61, intended to increase productivity, actually precipitated a decrease in pup production. For reasons that are not understood, pup production has continued to decline on the Pribilof Islands, and is currently approaching the low levels last seen after pelagic sealing ended. Pup production on the Commander Islands also increased following pelagic sealing, but numbers have stabilized during the last 30 years. Pup production on Robben Island was increasing until the late 1960s, but subsequently declined in the 1980s due to over-harvesting, and has recovered in recent years. Fur seals were thought to have been extirpated on the Kuril Islands until a small rookery was discovered in the 1950s, where pup production has steadily increased. Fur seals began breeding on San Miguel Island in the 1960s, where numbers of pups born has generally increased, except for sharp deceases coinciding with *El Nino* years. In 1980, fur seals began breeding on Bogoslof Island, where pup production has increased rapidly in recent years. Overall, pup production has declined by about 29% over the last 30 years due to a 54% decline on the Pribilof Islands; total combined pup production at the other breeding areas increased by 24% over the same period (Table 1).

Based on life tables derived from specimens collected during 1958-74, it is estimated the ratio of total number of animals to pups is about 3.8:1 in harvested stocks, and 4.5:1 in unexploited stocks. Population models predicted a slightly lower value of 3.6:1 for the declining Pribilof Island stock when subadult males were being harvested. A ratio of 4.0:1 was estimated for San Miguel Island based on the ages of immigrants to that rookery. Applying these multipliers, total abundance of northern fur seals is estimated to have declined by about 14% over the last 30 years (Table 1). The decline in total abundance over the last 30 years (14%) is less than the decline in pup production over the same period (29%) due to an increase in non-pup to pup ratios as commercial harvesting ended and fewer non-pups were removed from the population.

Table 1. Estimated changes in total abundance of northern fur seal population over the last 30 years (3 generations) between most recent surveys in 2005-2011 and 1975-1981.

Breeding Area	1975-1981			2005-2011		
	Pup Count	Multiplier	Stock Size	Pup Count	Multiplier	Stock Size
Pribilof Islands	241,977	3.6	871,000	111,600	4.5	499,000
Commander Islands	73,150	3.8	278,000	59,805	4.5	267,000
Kuril Islands	13,522	4.5	61,000	27,090	4.5	121,000
Robben Island	26,755	3.8	102,000	30,000	4.5	134,000
Bogoslof Island	2	4.5	9	22,905	4.5	103,000
San Miguel Island	1,038	4.0	4,200	2,465	4.0	10,000
Total Abundance	**356,444**		**1.32 million**	**253,865**		**1.13 million**

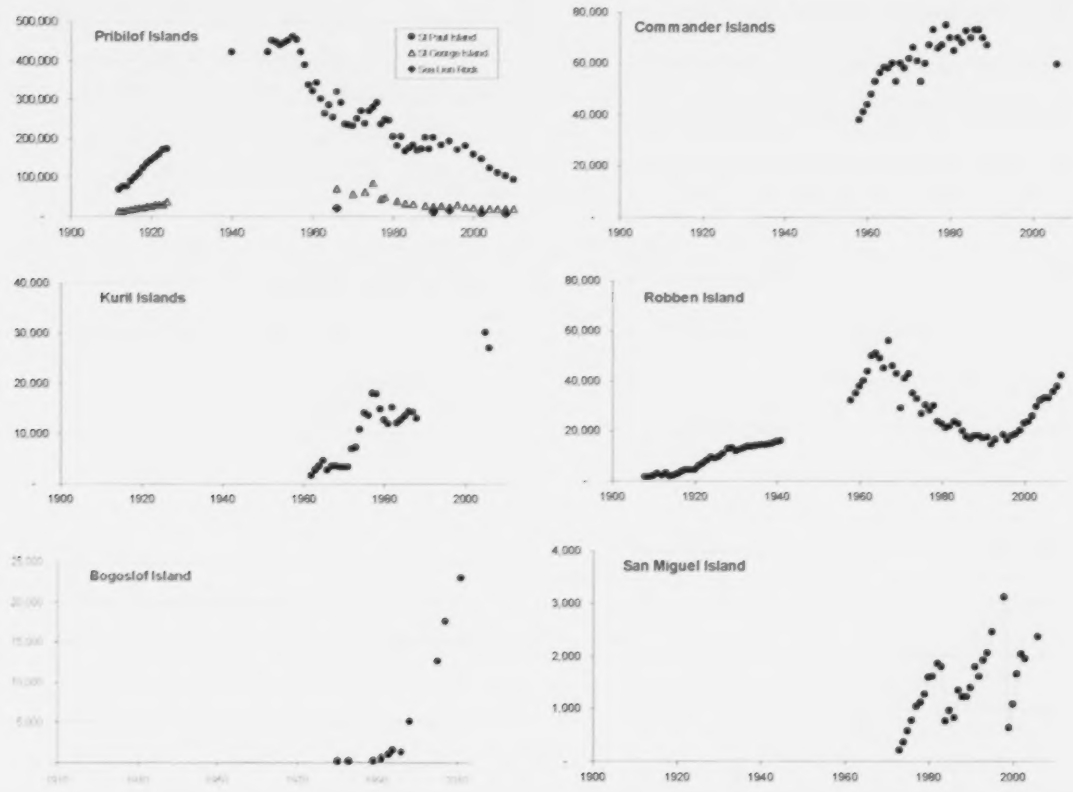

Figure 2. Recent trends in pup production at northern fur seal breeding areas. Note that the scale differs among sites depending on their relative size.

The specimens collected in coastal waters during 1958-74 in the North Pacific Fur Seal Commission (NPFSC) investigations indicated that juvenile and adult male fur seals were under-represented relative to adult females. Satellite telemetry studies conducted by the National Marine Mammal Laboratory's (NMML) Alaska Ecosystems Program during the past decade indicated that about 75% of adult females tagged on the Pribilof and Bogoslof Islands occurred in coastal waters along WCNA during peak abundance in March. Based on the degree to which other sex- and age-groups were under-represented in coastal areas, it was estimated that roughly 52% of fur seals from the Pribilof and Bogoslof Island subpopulations utilize coastal waters during the pelagic migration.

Flipper-tagging studies conducted during 1958-74 by the NPFSC indicate that seals from breeding populations inter-mix extensively during the pelagic migration. However, the population is not panmictic. Animals from the eastern breeding sites in the Bering Sea tend to migrate along the west coast of North America (WCNA), whereas animals from western breeding sites in Russia tend to migrate along the Asian coast. When adjusted for tagging effort and size of each subpopulation, it was estimated that seals born on Pribilof Islands were most likely to migrate along the WCNA. Fur seals born on the Commander Islands were 20% as likely and seals born on the distant Tyuleniy (Robben) Island only 4% as likely to migrate along WCNA as animals born on the Pribilof Islands.

Based on the size and migration patterns of each breeding subpopulation, it is estimated that abundance of seals migrating through Canadian waters has declined by about 29% over the last 30 years (3 generations) from roughly 165,000 to 118,000 seals (Table 2). During 1975-1981, the Pribilof Islands accounted for 93% of seals migrating through Canada, but with the recent declines and growth at other breeding sites, it currently accounts for 75% of seals migrating through Canada. Seals born on Bogoslof Island now account for about 15% of the seals migrating through Canada, and the Commander Islands account for about 8% of the seals migrating through Canada. The more distant breeding sites on the Kuril Islands and Tyuleniy (Robben) Island account for less than 1% each of the seals migrating through Canada. Fur seals from San Miguel Island also winter in Canadian waters, but the contribution of this relatively small subpopulation to total abundance in Canada has not been assessed.

Table 2. Estimated changes in peak seasonal occurrence of northern fur seals in Canadian waters over the last 30 decades (3 generations) between the most recent survey in 2005-2011 and 1975-1981. The estimates account for the differences in size of each breeding site and propensity of animals from each site to migrate along the WCNA.

Breeding Area	1975-1981			2005-2011		
	Stock Size	% Migrating through Canada	Peak Seasonal Abundance	Stock Size	% Migrating through Canada	Peak Seasonal Abundance
Pribilof Islands	871,000	18%	154,000	499,000	18%	88,200
Commander Islands	278,000	3.5%	9,700	267,000	3.5%	9,300
Kuril Islands	61,000	0.8%	500	121,000	0.8%	900
Robben Island	102,000	0.8%	800	134,000	0.8%	1,000
Bogoslof Island	9	18%	2	103,000	18%	18,200
San Miguel Island	4,200	+	+	10,000	+	+
Peak Seasonal Abundance			165,000			118,000

Threats and Limiting Factors

The cause of the declines on the Pribilof Islands has not been identified, but potential threats include changes in prey availability, climate change, entanglement in debris, oil spills and contaminants.

Northern fur seals are probably ultimately limited by the availability of suitable prey, principally small-schooling forage fish and pelagic squid. Changes in prey availability can be caused by natural or anthropogenic factors, such as changes in ocean climate, fishing, or natural cycles and regime shifts. Competition with other apex predators, such as sea lions, can also affect prey availability.

Prey availability may be particularly important adjacent to rookeries during the breeding season. Northern fur seal pups are confined to land and dependent on their mothers for the first 4 months of life. The energetic requirements of lactating females are high. However, females must return to rookeries regularly to suckle their young, and are thus limited to foraging within

about 100 kilometers of breeding sites. It is generally thought that fur seals migrate to breeding sites at higher latitudes to take advantage of seasonally abundant prey resources.

The coastal waters off WCNA are important foraging areas for fur seals. It has been estimated that fur seal wintering off WCNA consume an average of about 3.1 kg per day. It is not known if prey availability within this area is currently limiting productivity of fur seal populations. Seals from St. Paul Island, St. George and Bogoslof Islands in the Bering Sea all exhibit similar migration patterns and have similar diets, suggesting they are utilizing similar prey resources off WCNA. However, the 3 breeding sites have exhibited very different trajectories in recent years, with St. Paul Island continuing to decline, St. George Island being relatively stable, and Bogoslof Island exhibiting rapid growth. This suggests that foraging conditions in the vicinity of each breeding site may be more important in determining productivity levels.

Habitat and Residence Requirements

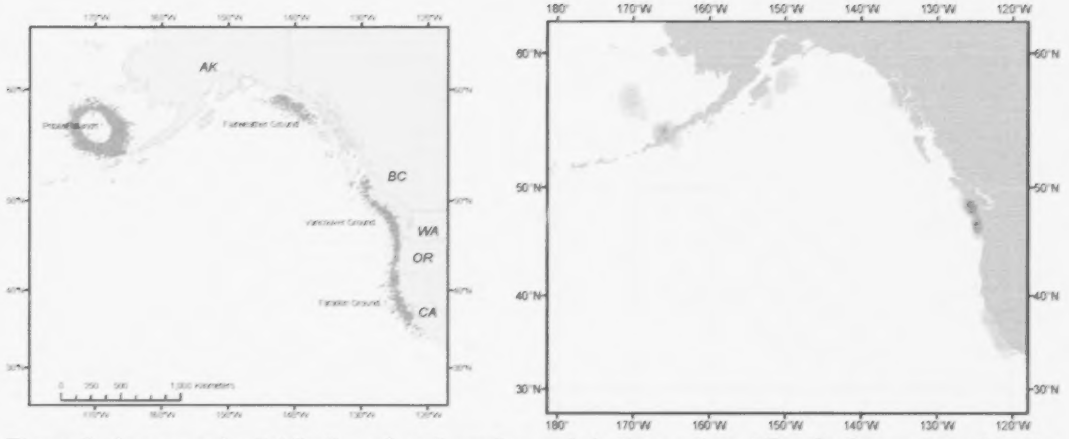

Figure 3. Large-scale distribution of northern fur seals in the northeast Pacific Ocean based on the location of seal harvests during 1881-1911 (left) and specimen collections made during the NPFSC research program during 1958-74 (right).

Our understanding of the distribution of fur seals during their pelagic migration is based largely on historical sealing logbooks recorded from 1868-1911, pelagic research sightings and collections made during 1958-1974, and platform of opportunity sightings made during 1958-2007. Sample sizes are small, but more recent satellite tracks of migrating seals captured and tagged on the Pribilof and Bogoslof Islands indicate they continue to utilize the same range, with the majority of adult females utilizing the waters along the west coast of North America, but considerable numbers also utilizing offshore areas especially along the transition zone.

As indicated above, northern fur seals do not breed and rarely come ashore in Canada, but migrate seasonally through Canadian waters between December and June. The waters off Washington State and southern Vancouver Island, known as the "Vancouver Ground", was an important sealing area (Figure 3). The same area also accounted for a large proportion of specimens collected during the NPFSC research program (Figure 3). Platform of opportunity sightings and satellite telemetry data indicate these areas continue to be used. Collectively, the available data suggest this area has been utilized by seals for over a century.

Critical habitat has not been defined for fur seals in Canada, but the main concentration occurs on La Perouse Bank off southern Vancouver Island. The 22,000 km^2 area shown in Figure 4 accounted for 75% of the specimens collected and 73% of fur seal sightings during NPFSC

research program during 1958-74. It also accounted for about one-third of the fur seals harvested by sealers in Canadian waters, but recent satellite telemetry data indicate adult females may now be utilizing an area more seaward along and off the shelf break. The area is utilized predominately by adult females during April-June. This represents an important time of year for pregnant females, as they gain weight prior to making the open ocean trek back to breeding sites. Arriving on rookeries in good body condition may be important if, as suggested above, foraging conditions in the vicinity of breeding sites influences productivity of fur seal subpopulations.

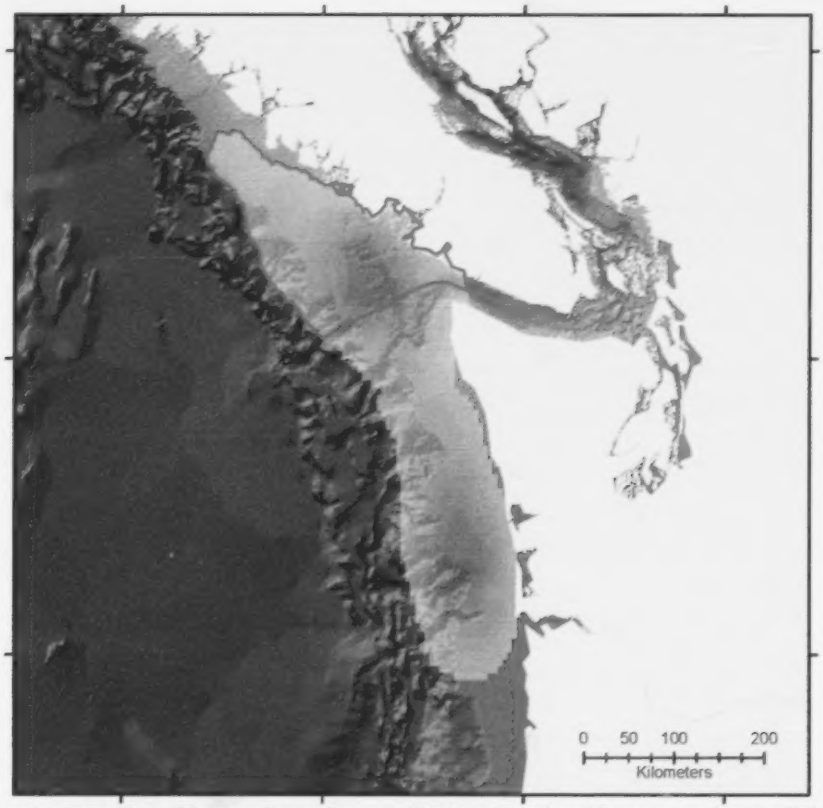

Figure 4. Main concentration of fur seal specimen collections on the "Vancouver Ground" that extends from the Columbia River to southwest Vancouver Island (red shaded polygon). The red line delineates the highest density area in Canadian waters which accounted for 75% of research specimens and 73% of sightings in Canada.

The extended shelf area of La Perouse Bank is highly productive, and supports large stocks of herring, sardines, hake and other potential fur seal prey. Sardines, which have re-appeared and increased in abundance in B.C. in recent years, tend to occur further offshore than herring, which have recently declined in abundance. Maintenance of adequate prey resources in this area is probably critical for maintaining the abundance of migratory fur seal in Canadian waters.

SARA defines residence as: "*a dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating*". As such, the concept of residence does not apply to northern fur seals during their pelagic migration through Canadian waters.

Recovery Objectives and Time Frame for Recovery

Since fur seals migrating through Canadian waters originate from breeding sites outside of Canada, a key distribution objective for sustaining fur seals in Canada is to maintain viable breeding populations that occur outside of Canada. Genetic studies indicate that an effective population size (N_e) of about 1,000 animals provides a conservative estimate above which significant loss of additional genetic variation is not expected. Effective population size represents the number of breeding adults, which is less the total population size (N), especially for a polygamous species like the northern fur seal. Based on the observed ratio of territorial bulls to pups, which provide an index of the number of reproductive females, the average harem size on the Pribilof Islands was 31 females per territorial bull. Given this disparity in sex ratio, a total population of about 8,100 animals would be required to maintain an effective population size of 1,000 animals.

COSEWIC determined that northern fur seals were threatened due to continued declines on the Pribilof Islands. A population viability analysis, which integrated information on population size, population trajectories and natural variability in pup production, was used to assess the risk of and time to quasi-extinction (N_e<1,000 or N<8,100) for the declining Pribilof Island subpopulation. It was estimated that risk of quasi-extinction was low (0.1-0.3%) within the next 100 years, with mean time to quasi-extinction estimated to be 161-199 years. However, if the recent declines continue the risk of extirpation escalates (Figure 5). None of the other breeding subpopulations have exhibited declines, and there is little risk of quasi-extinction within the next 100 years.

Specific recovery objectives have not been established for fur seals in Canada, but the obvious focus would be on halting the declines on the Pribilof Islands. An overall population objective will need to consider the abundance, population trends, and migration patterns of animals associated with each breeding site. The large, declining Pribilof Island subpopulation currently has the greatest influence on abundance of seals in Canada. Some but not all of the declines on the Pribilof Islands can be attributed to the re-distribution of animals to Bogoslof Island. The Bogoslof Island subpopulation is much smaller, but has exhibited rapid growth in recent years, and an increasing proportion of animals migrating along WCNA and through Canadian waters originate from this subpopulation. Appreciable numbers of animals also originate from the large, stable breeding subpopulation on the Commander Islands. Despite their recent growth, animals from the most distant subpopulations on the Kuril Islands and Tyuleniy (Robben) Island show little propensity to migrate along WCNA, and have relatively little influence on numbers of animals migrating through Canadian waters.

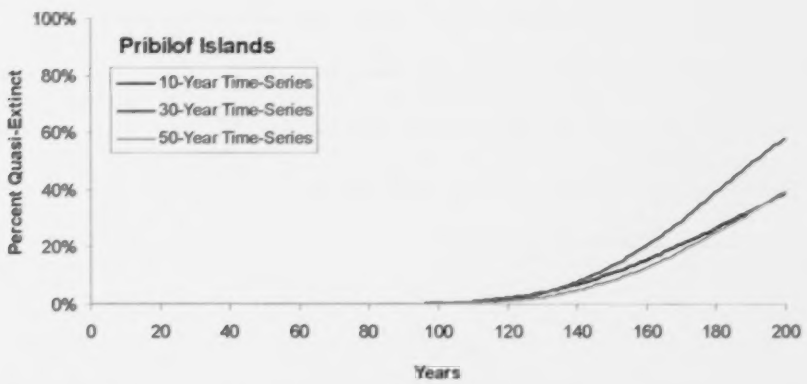

Figure 5. Estimated probability of the northern fur seal population declining below quasi-extinction thresholds (N_e<1,000 or N<8,100) in the next 200 years.

It is unclear whether northern fur seals can be restored to peak historic levels. The fur seal is one of several pinniped predators utilizing prey resources along WCNA. Peak levels of fur seals occurred in the 1950s, at which time the abundance of California sea lions, Steller sea lions, and harbor seals had been reduced by predator control programs and over-harvesting. However, the latter species have recovered since being protected in the early 1970s. While these pinnipeds exhibit different foraging patterns, their diet overlaps, and they often target the same prey stocks. For example, fur seals off southwest Vancouver Island prey mainly on herring that are feeding on La Perouse Bank, whereas sea lions prey on the same herring stock in coastal areas off southern Vancouver Island, and both sea lions and harbour seals prey on the same herring stock when it moves into the Strait of Georgia to spawn. Harbour seal populations appear to have attained carrying capacity, and there has been a slowing in the growth rate of California sea lion populations, suggesting prey availability may be limiting these populations. There is also evidence that seals and sea lions may be limiting productivity of herring stocks by reducing survival rates and selectively removing larger fish. Thus, there is likely inter-specific competition for limited prey resources in coastal waters off British Columbia.

Sources of Human Induced Mortality and Harm

The cause of the declines in fur seals on the Pribilof Islands has not been identified, but direct human-induced mortality does not appear to be an important factor. The annual Potential Biological Removal (PBR) for fur seals in the eastern North Pacific (Pribilof and Bogoslof Islands) has been estimated to be 13,809 seals per year. Being a depleted stock, this is a conservative estimate using a recovery factor of 0.5. There are only 4 recorded instances of fur seals being caught in fishing gear in B.C. during the last 25 years, two in bottom trawls, one in a gillnet, and one in a seine net. A few animals (average about 3 per annum over last 3 years) are taken incidentally in U.S. fisheries. Large numbers of juvenile fur seals (e.g. an estimated 2,405 fur seals in assessment conducted during 1990) were taken in the high seas Japanese squid drift net fishery than began in 1978 and continued until 1992. There is a small subsistence harvest of subadult males on the Pribilof Islands (average 530 per annum over past 5 years), but takes are miniscule compared to the large commercial harvests that had been sustained for many decades. A small proportion (0.20-0.35%) of animals, mainly young males, are observed at breeding areas entangled in fishing net fragments, packing bands, and other debris. It is probable that additional animals become entangled and die at sea, but it is difficult to determine the total extent of mortality from the entanglement rates observed on land.

Sources of Uncertainty

Life tables and population models have been developed based on a large number of specimens collected during the NPFSC research program during 1958-74. However, these data are somewhat dated, and there is insufficient information to assess how recent changes in vital rates such as age at maturity, fertility and survival are affecting the trajectories of the breeding subpopulations. This affects the accuracy of estimating total population size from pup counts. In particular, there is uncertainty regarding the population biology of mature males, most of which were being harvested when the pelagic specimens were collected. The male harvests were intended to remove the superfluous biomass of redundant males, thus increasing the productivity of reproductive females. It remains unclear whether the termination of male harvests may be now be having the opposite effect of reducing the productivity of reproductive females

Most of the information on distribution and migration patterns from sighting and kill data lack accurate estimates of effort. Moreover, there are potentially major sampling biases. Both the sealers and seal researchers appear to have spent most effort in coastal areas where seals

congregate in higher densities, and largely ignored lower densities of fur seals in offshore areas. The platform of opportunity sightings show the almost ubiquitous distribution of fur seal sightings across the North Pacific, but effort was severely biased toward summer months. Nevertheless, all 3 data sources indicate that high aggregations of fur seals occur in specific locations, such as the "Vancouver Ground" off Washington and southwest Vancouver Island. Satellite telemetry supports this general pattern, and is providing greater insight into utilization of other areas such as the front of the transition domain. Satellite tagging of fur seals captured while in Canadian waters would provide additional insight into the origin and movements of animals frequenting our waters.

Estimates of the abundance of fur seals along WCNA and Canadian waters involve a number of assumptions about the sex- and age-structure of the population, and segregation by sex and age during the pelagic migration. Given the age of the NPFSC data, fluidity of seal movement patterns, and relatively small sample sizes for satellite-tagged animals, these estimates should be regarded as crude approximations.

It is difficult to extrapolate population trends even a few years let alone a century into the future. Population viability analyses (PVA) are not intended to provide precise predictions, but rather serve as a tool for assessing the probability of extirpation or quasi-extinction given current abundance levels assuming that recent population trends continue. While the PVA indicates that none of the breeding subpopulations of northern fur seals are at risk of extirpation in the foreseeable future, these analyses will need to be updated and the risk of extirpation reassessed periodically as new survey data become available.

The diet data for fur seals along WCNA and in Canada were also collected during the NPFSC research program in 1958-74, and are quite dated. The Strait of Georgia spawning stock of herring, currently the largest herring stock along WCNA, migrates to and feeds on La Perouse Bank. This likely explains the high concentration of fur seals on the continental shelf area off southwest Vancouver Island. However, the west coast Vancouver Island herring spawning stock that also feeds on La Perouse Bank has declined in recent years, whereas the abundance of other potential prey resources, such as sardines, have increased dramatically in recent years. Sardines tend to occur further offshore than herring, and preliminary examination of satellite telemetry data for adult female fur seals indicate that the main foraging area off southwest Vancouver Island may have shifted offshore to the area along and seaward of the shelf break. Updated information on fur seal feeding habits would be useful, and the satellite telemetry data warrant further analyses.

The prey requirements of fur seals along the WCNA and in Canada need to be assessed in the broader context of other predators, including humans. With the development of large-scale fisheries, and recovery of other pinniped populations, the ability of prey populations to support apex predators at historic level needs to be evaluated using bioenergetics and ecosystem models.

SOURCES OF INFORMATION

This Science Advisory Report is from the Annual meeting of the National Marine Mammal Peer Review Committee (NMMPRC), 2011 held October 17 – 21, 2011. Additional publications from this process will be posted as they become available on the Fisheries and Oceans Canada Science Advisory Schedule at www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

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ISSN 1919-5079 (Print)
ISSN 1919-5087 (Online)
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CORRECT CITATION FOR THIS PUBLICATION

DFO. 2012. Recovery potential assessment for the northern fur seal (*Callorhinus ursinus*) in Canadian waters. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2012/057.